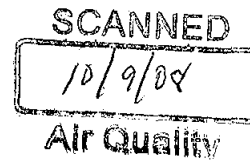


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September 18, 2008

Mr. Kyrik Rombough
South Dakota Department of Environment and Natural Resources
Air Quality Division
523 East Capitol
Pierre, SD 57501

RECEIVED
SEP 19 2008
AIR QUALITY
PROGRAM

**Subject: Basin Electric Power Cooperative NextGen Project
Response to Comments on Air Quality Permit Application,
Monitored Data, and Modeling Protocols**

Dear Mr. Rombough,

On behalf of Basin Electric Power Cooperative, ENSR is responding to comments that have been provided by your agency, the South Dakota Department of Environment and Natural Resources (SDDENR) regarding the NextGen air permit application, the air quality and meteorological data that were used in support of that application, and on the modeling protocols that supported the modeling effort. This letter provides a comprehensive response to comments that your agency has provided, including the forwarded comments from the National Park Service (Federal Land Managers, or FLMs) regarding impacts on Class I Areas.

The letter summarizes each comment and provides a response, indicating an enclosed item if appropriate.

- (1) SDDENR requested a copy of the quarterly report for the first quarter's monitoring at the site near Gettysburg, SD. The monitoring period for this report includes data collected from April through June 2007. A copy of that report is enclosed.
- (2) SDDENR requested a data listing in electronic format for all the hourly air quality data that were collected electronically at this site. An annual report summary of the collected data has been prepared and a copy of that summary is also enclosed. The report summarizes the data for the full 15-month monitoring period from April 2007 through June 2008. Monthly data are generally provided, but the wind roses that are included in that report represent the period for which the AERMOD modeling was conducted using the collected meteorological data. An electronic copy of the full hourly collected meteorological data was included with the modeling compact discs that were submitted with the PSD permit application. The hourly air quality data are provided on a compact disc that is included as an appendix in this annual report. Note that the PM₁₀ data were collected on 24-hour sample filters, which were sampled on a 6-day schedule with a filter and are not provided electronically.
- (3) In its review of the original air quality monitoring plan, SDDENR requested that Basin Electric "consider" installing a monitoring program for PM_{2.5}. See Letter dated January 25, 2007. Basin's response dated March 6, 2007 indicated that *"Basin Electric is proposing a separate PM_{2.5} monitoring program that involves a continuous monitor in accord with California Air Resources Board monitoring protocols. We are not proposing to monitor PM_{2.5} with the reference method due to the extreme sensitivity of sample handling and retrieval."* On June 27, 2007, Basin and ENSR met with SDDENR in Pierre to discuss the project including the monitoring program. We reviewed the status and discussed the planned

monitoring for PM_{2.5} using the BAM 1020 continuous PM_{2.5} air sampler. SDDENR basically agreed with the proposed approach.

As part of the final review of the monitored data, SDDENR requested information regarding the flow checks that were conducted on the BAM 1020 PM_{2.5} monitor. Basin and SDDENR were aware that the PM_{2.5} data continuous sampler was not a federal equivalent method when it was installed in June 2007, but expected acceptance shortly thereafter. Following approval of this system as a FEM, the sampler was modified on September 28 2007 with the installation of a reference inlet and control system in accord with the federal equivalent reference method. Regarding the flow checks, the BAM 1020 measures flow rates continuously, and this flow is recorded hourly and reported via modem along with a number of other operational parameters. In the first non-FEM BAM 1020 units received, ENSR noted that recorded hourly flow rates were not very consistent. Following FEM implementation, the recorded hourly flow rates became very steady at 16.7 liters per minute.

Monitoring Regulations published in the Federal Register in October 2006, 40 CFR 58 Appendix A, Table A-2 recommends flow checks for continuous particulate monitors be conducted monthly for SLAMS sites. This guidance does not specifically cover PSD applications. The quality control guidelines in the BAM 1020 Class III FEM manual published during the spring of 2008, recommend that flow checks be conducted each time the tape is changed, which for the NextGen monitoring program is about every 2 months or so.

The latest guidance in the QA Handbook from EPA was published in August 2008, after the end of the NextGen Monitoring Program, and it requires that SLAMS sites perform flow checks once a month. EPA has said that this guidance was not meant for PSD.

For the NextGen monitoring program, flow checks were performed on the following occasions:

Date	Description	Unit 1	Unit 2
June 2007	Factory Calibration	X	X
8/2/07	Factory Calibration (FEM)		X
7/10/07	Installation	X	
9/29/07	Installation		X
November 2007	Factory Calibration (FEM)	X	
12/5/07	Installation	X	
12/5/07	Quarterly	X	X
3/4/08	Quarterly	X	X
4/24/08	Quarterly	X	X
7/23/08	Quarterly/Final	X	X

As a result, there were a total of 8 flow checks on Unit 1 and 7 flow checks on Unit 2. All flow checks revealed that proper flows were being maintained in the instrument, and that no restrictions or blockages occurred in the system. The quarterly calibrations of the BAM 1020 monitors are documented in the quarterly calibration reports. With the installation of the federal equivalent method equipment and recording of hourly flow measurements, and the quarterly calibration flow checks, the NextGen program well exceeds the requirements for flow monitoring for the BAM 1020 PM_{2.5} monitor. Leak checks and other maintenance

activities were performed in addition to these flow checks to assure that the data are correct.

- (4) SDDENR requested that we provide a separate summary of the PM_{2.5} data for the period prior to the installation of this reference cyclone and after the installation of this unit. Attachment 1 provides a monthly summary and a daily time series of the 24-hour readings of the PM_{2.5} primary sampler, along with a concurrent depiction of the six-day PM₁₀ 24-hour samples that were collected during the same time period.

The results show a consistent pattern of readings, with monitored levels slightly higher before September 28, 2007. The overall average for the first three months was 11.3 µg/m³, and the highest 24-hour average during that same time period was 25.2 µg/m³. The overall average during the period October 2007 through June 2008 was 3.9 µg/m³, or about one-third of the average for the earlier period. The highest 24-hour PM_{2.5} reading was 22.0 µg/m³ during that same 9-month period. As a result of this comparison, we expect the pre-September 28 data to be a conservative estimate of the levels that would have been monitored with the FEM cyclone head.

- (5) Also as requested, we compared the results of the PM_{2.5} monitoring program to data collected by SDDENR at a site near Aberdeen SD. The results are provided in Attachment 2, indicating the 98th percentile PM_{2.5} reading for each of three years, along with the annual average PM_{2.5} reading for all three years, and the three year composite averages. The data show remarkable consistency between the monitored data near Gettysburg, SD and Aberdeen. The use of either set of data in the application, as representative of background PM_{2.5} levels, would continue to result in the demonstration of compliance with the ambient air quality analyses.
- (6) SDDENR requested two additional hard-drives of the CALPUFF input and output files for the modeling that was submitted with the application. Those hard drives will be submitted shortly under a separate cover.
- (7) SDDENR requested an electronic copy of the spreadsheets that were used in the BACT calculations to address cost effectiveness. A hard copy of that spreadsheet is included as Attachment 3, and an electronic version will be e-mailed separately.
- (8) SDDENR requested a copy of the output from the TANKS program that was used to calculate emissions from the fuel oil storage tanks at NextGen. A copy of those output results is provided in Attachment 4.
- (9) SDDENR requested additional data for comparison regarding the control technologies that were analyzed under the BACT process, but were not selected as BACT. Since Basin selected the top-performing control technology in these analyses, some of the lower-performing control technologies were not included in the summary. Attachment 5 provides an updated series of tables for the application that indicate the performance levels for control technologies that were considered, but not included in analyses because a higher-performing technology was chosen as BACT. These tables can be compared directly to the tables reference in the PSD permit application dated July 28, 2008.
- (10) The FLM comments are limited to four separate issues, specifically: use of NPS-approved Class I receptor sets; reporting of acid deposition rates and comparison to the FLM

Deposition Analysis Thresholds (DATs); appropriateness of wind height measurements for VISCREEN; and speciation of particulate emissions and modeling of condensable species. The FLM comment is re-stated directly from John Notar's e-mail, and ENSR's response is provided below each comment.

10.a FLM Comment:

Overall the protocol is satisfactory. But before we give a final approval of the protocol they should contact Don Shepherd of the NPS Air Resources Division at (303)-969-2075 regarding the proposed speciation of the particulate emissions. Don's comment is that he would like to see the actual emission rates and stack parameters prior to approving the protocol. I am especially interested, as usual, in how ENSR handles the condensible inorganics. It is my contention that condensable inorganics consists of more than just the H₂SO₄ (e.g., HCl and HF) and that those other components are also hygroscopic and should therefore be modeled as if they are hygroscopic sulfates.

Response:

Tables 1 and 2 below provide the actual emission rates and stack parameters proposed for modeling the main stack, as requested by the FLMs. The PM₁₀ emissions were speciated based on guidance published by the NPS for PM₁₀ emitted from Coal Fired Boilers.¹

Table 1 Modeled Emission Rates

Pollutant	Annual BACT Emission Rates		Short-term, 24-hour Emission Rates (lb/hour)
	(tpy)	(lb/hour)	
NO _x	1,533	350.0	560.0
SO ₂	1,533	350.0	350.0
PM ₁₀	1,012	231.0	231.0

Table 2 Modeled Stack Parameters

Source	Location in UTM Zone 14 NAD27 (meters)		Stack Height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)
	Northing	Easting					
Main Stack	413233	5037877	172.6	570.1	8.60	18.30	330.4

The FLMs requested more information regarding the treatment of condensable inorganic emissions. Specifically, the FLMs suggest that condensable inorganic emissions consist of more than just sulfuric acid and also include halogens such as hydrogen chloride (HCl) and hydrogen fluoride (HF). The FLMs are concerned that the uptake of water by these hydrophilic halogens creates an aerosol that contributes to light extinction and that these species are not included in the reported light extinction.

¹ Speciation data was obtained from <http://www.nature.nps.gov/air/permits/ect/ectCoalFiredBoiler.cfm>.

Basically, the contribution of coal-fired combustion emissions to visibility degradation is due to scattering and absorption of sunlight by primary and secondary particles. Primary particles occur in two forms: filterable and condensable. Filterable particulate emissions are defined as those that are present in solid form upon exiting the stack. Condensable particulate emissions are comprised of semi-volatile substances that are in the vapor form in the combustion zone and within the stack, but which readily condense as particulate once the plume is cooled to ambient temperature. An example of condensable particulate species is sulfuric acid (H_2SO_4), which forms a mist at ambient temperatures, but is in vapor form in the stack gas when emitted.

Secondary particles are formed by chemical reactions of gases and vapor phase constituents in the power plant plume long after it has cooled to ambient temperature and traveled a considerable distance. For example, ammonium sulfate is a secondary particulate species which is formed by the oxidation of SO_2 to form SO_3 and H_2SO_4 in combination with reactions with ammonia present in the atmosphere to form ammonium sulfate. A secondary process is the formation of HNO_3 (nitric acid, present in vapor form at ambient conditions) from NO_x emissions and subsequent partial transformation conversion to ammonium nitrate. Sulfate formation is preferential to nitrate formation because H_2SO_4 is much more soluble than HNO_3 . In power plant plumes, because of the degree to which ambient ammonia is used to form sulfates, the formation of nitrates is often limited.

In contrast to sulfate and nitrate, there is little evidence that the relatively low concentrations of HCl and HF present in power plant plumes similarly result in reactions with ammonia that contribute substantially to airborne particulate. An important reason is that emissions of SO_2 and NO_x are much greater such that once sulfates and nitrate formation has taken place, there is a very limited amount of ammonia available in the plume. As discussed below, there are also other limiting factors that reduce the likelihood that secondary particulate formation of ammonium chloride and ammonium fluoride is important in power plant plumes.

HCl and HF have significantly different physical and chemical properties compared to those of H_2SO_4 . Due to the H_2SO_4 very low boiling point and vapor pressure in the atmosphere, it will condense as a hygroscopic liquid aerosol and virtually no sulfuric acid will be in the vapor phase. Reactions with ambient ammonia within these droplets form a secondary particulate, ammonium sulfate. In contrast, due to its very low boiling point and high vapor pressure (see chemical properties in Table 3 and Table 4), HCl exists in vapor form in the atmosphere, and therefore, unlike sulfuric acid, will not condense as an aerosol. In addition, Meng et al. (2000)² indicate that HCl does not react with ammonia vapor unless the concentration of ammonia exceeds 25 ppm. Because this level of ammonia is several orders of magnitude greater than the level of ammonia commonly present in the ambient air (typically 10 ppb or less), it is highly unlikely that secondary particulate will form by this mechanism. Although in-stack concentrations of ammonia at facilities with selective catalytic reduction NO_x controls is generally required to be about 2 ppm or less, any particles that form in the stack would already be measured as part of the primary particulate emissions.

² Meng, R.Z., P. Karamchandani, and C. Seigneur, 2000. Simulation of Stack Plume Opacity. J. Air & Waste Manage. Assoc., Vol. 50, 869-874.

Under enclosed saturated conditions, HF can condense as a liquid at cold temperatures (boiling point of 20°C). However, because the saturation vapor pressure is very high at ambient temperatures (0.1 to > 1 atm), HF readily volatilizes. As such, like HCl, HF in the atmosphere is present as a vapor and the formation of particulate ammonium fluoride is unlikely. In addition to these factors, the formation of secondary ammonium fluoride is further limited because HF is much less soluble than even HCl, which in turn is much less soluble than H₂SO₄. This property is consistent with the vapor pressure properties of sulfuric acid in comparison with the other acids, as listed in Table 4. In a mixture of acids with different vapor pressures and solubilities, the solubility of more volatile (or less soluble) acids is inhibited. Thus, in power plant plumes, the presence of H₂SO₄ will inhibit the dissolution of HNO₃, HCl and, especially, HF. The CALPUFF model already considers this effect (in part) by favoring the formation of ammonium sulfates over ammonium nitrates, since there is limited ammonia available for these reactions.

HCl and HF are highly soluble in water. That raises the question as to whether this property would increase the formation of aerosol droplets and thus somehow act as a more efficient scatterer of light by forming hygroscopic particles. As noted above, HCl and HF do not exist as liquids or in particle form as ammonia salts. In the presence of naturally occurring water droplets, HCl and HF will merely dissolve into these preexisting droplets, but this will not change the nature of the light scattering of these naturally occurring aerosols, or create new aerosol droplets.

Furthermore, the proposed modeling approach regarding condensable inorganic species is consistent with findings from scientific studies, as well as with previous project applications. It has been found that the presence of other, non-sulfate, species has little effect on the uptake of water. "The hygroscopic growth of particles during the 1995 SEAVS experiment was found to be well-explained by assuming that only the sulfate species were hygroscopic, suggesting that the presence of other species had only a minimal effect on the uptake of water by these aerosols."³ Therefore, consistent with the modeling approach proposed in the modeling protocol, primary PM₁₀ emissions should not consider HCl and HF in either aerosol liquid form or in the form of ammonia salts.

Table 3 Thermodynamic Parameters

Compound	State at 298 K	Melting Point (K)	Boiling Point (K)	Vapor Pressure (ATM)
HF	Gas	190	293	1.20
HCl	Gas	159	191	46.92
H ₂ SO ₄	Liquid	281	558	1.38E-06
HNO ₃	Liquid	232	357	0.06
NH ₃	Gas	195	240	9.86

³ "Estimates of aerosol hygroscopicity during the Southeastern Aerosol and Visibility Study," Journal of the Air and Waste Management Association. May, 2000.

Table 4 Solubility in H₂O @ 298K [M/atm] ($C_{aq,A} = pA \times H^*$)

Compound	Physical Henry's Law H	Effective Henry's Law H* at pH = 5.6	Effective Henry's Law H* at pH = 3.0
HF	2.74E+04	3.85E+06	3.70E+04
HCl	1.10E+00	7.44E+11	1.87E+09
H ₂ SO ₄	2.50E+14	4.77E+25	5.50E+20
HNO ₃	2.10E+05	1.25E+12	3.15E+09
NH ₃	6.10E+01	6.96E+01	3.48E+03

10.b. FLM Comment:

They did not mention the NPS approved Class I receptors for the 2 parks. ENSR can download them from the NPS web site, they are aware of the site and know how to get them.

Response:

ENSR stated in the modeling protocol on page 3-2, Section 3.4.2: "Receptor locations and elevations for Badlands and Theodore Roosevelt NPs will be obtained from the NPS Nature and Science web site." These receptors were used in the modeling analysis.

10.c. FLM Comment:

Although the proposed VISCREEN analyses are just for the 4 State of South Dakota recreation areas, I have the following comment. I discussed this with the Fish and Wildlife Services meteorologist Tim Allen here in Denver and we both agree that the proposal to use the 100 meter winds from the on-site meteorological tower is incorrect. For VISCREEN they should use the 10 meter winds from the on-site meteorological tower for transport wind speed and direction. This is the normal method used for VISCREEN. The proposed use of the 10 meter winds for stability is correct.

Response:

EPA's Workbook for Plume Visual Impact Analysis indicates that the plume transport wind speed is used in the VISCREEN analysis and does not reference a preferred height. The main stack at the facility is well over 172 meters feet high. Given the availability of site-site wind measurements at 10 meters and 100 meters, the protocol proposed to use the 100 meter wind data to represent plume transport. The 100 meter wind data provides a more representative measurement of stack top conditions than does the 10 meter wind data.

This approach is consistent with guidance in Appendix W, Section 8.3.3.2(a): "site specific measurements of ambient air temperature, transport wind speed and direction, and the variables necessary to estimate atmospheric dispersion should be available in meteorological data sets to be used in modeling", emphasis added. Note that Appendix W, like the *Workbook*, does not dictate a specific level for wind data measurements, rather the guidance cites a "transport" level. For these reasons, ENSR proposes to use the 100-meter level wind data as

Kyrik Rombough
September 18, 2008
Page 8

representative of local transport in the VISCREEN analysis. As stated in the FLM comment, ENSR did use the 10-meter observations to calculate stability class.

10.d. FLM Comment:

They should report the results for acid deposition of total nitrogen and total sulfur and should address the Federal Land Managers Deposition Analysis Threshold (DATs) of 0.005 kilograms per hectare per year (kg/ha/yr) developed for the western states for both total nitrogen and sulfur.

Response:

ENSR stated in the modeling protocol on page 5-3, Section 5.4: "CALPUFF will be used to model both wet and dry deposition of SO₂, SO₄, nitrates (NO₃), and nitric acid as well as dry deposition of NO_x to estimate the maximum annual wet and dry deposition of sulfur and nitrogen at the Class I areas. Since all potentially affected Class I areas are west of the Mississippi River, the selected DAT for this project is 0.005 kg/ha/yr."

Sincerely yours,



Bruce C. Macdonald
Senior Program Manager



Patrick McKean
Air Quality Modeler

Cc: Cris Miller, Basin Electric
Greg Knauer, Burns & McDonnell

Ref: 02450-017

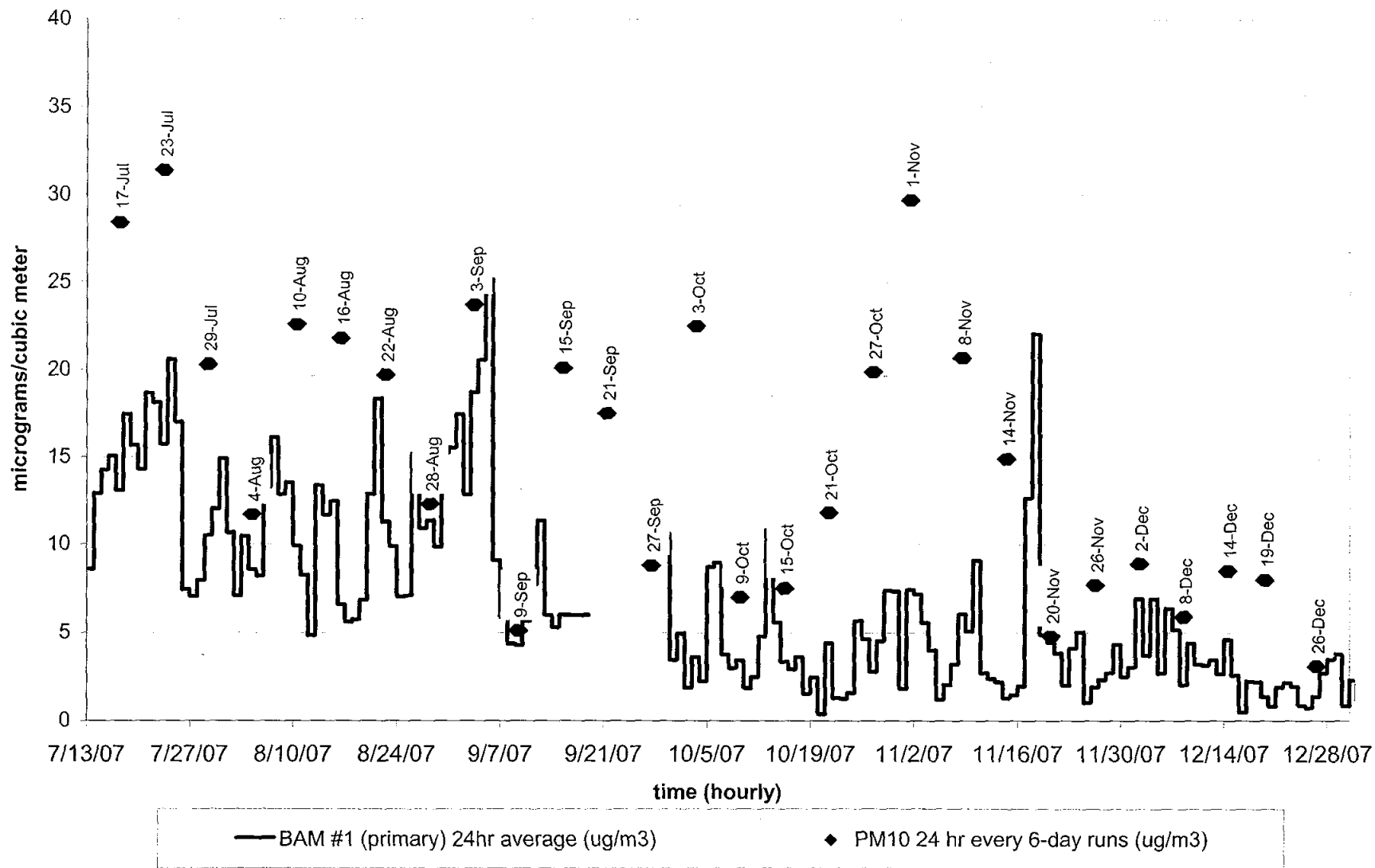
Enclosures.

Gettysburg, SD

BASIN BAM PM _{2.5} BAM Sampler #1 (primary)	monthly average $\mu\text{g}/\text{m}^3$	monthly max 1 hr av. $\mu\text{g}/\text{m}^3$	date max 1 hr occurred	monthly max 24hr av. $\mu\text{g}/\text{m}^3$	date max 24 hr average occurred	quarterly average $\mu\text{g}/\text{m}^3$
July 2007 (non FEM)	13.8	45.0	07/22/07	20.6	07/24/07	
August 2007 (non FEM)	10.7	77.0	08/30/07	18.3	08/21/07	
Sept. 2007 (non FEM until 9/28)	9.9	78.0	09/12/07	25.2	09/05/07	11.3
October 2007 (FEM)	4.0	20.0	10/29/07	10.8	10/13/07	
November 2007 (FEM)	4.6	32.0	11/18/07	22.0	11/18/07	
December 2007 (FEM)	2.9	23.0	12/18/07	6.9	12/02/07	3.8
January 2008 (FEM)	3.0	18.0	1/11/08	8.6	1/15/08	
February 2008 (FEM)	4.2	27.0	2/24/08	12.4	2/24/08	
March 2008 (FEM)	3.8	22.0	3/31/08	9.5	3/29/08	3.7
April 2008 (FEM)	4.7	22.0	4/15/08	10.7	4/20/08	
May 2008 (FEM)	5.1	29.0	5/1/08	19.9	5/1/08	
June 2008 (FEM)	3.2	21.0	6/5/08	10.4	6/29/08	4.3
Annual	5.8	78	7/12/2007	25.2	9/5/2007	thru 6/30
July -Sept 2007 (non FEM)	11.3	78	09/12/07	25.2	09/05/07	
Oct 2007 - June 2008 (FEM)	3.9	32.0	11/18/07	22.0	11/18/07	

BASIN BAM PM _{2.5} BAM Sampler #2 (collocated)	monthly average $\mu\text{g}/\text{m}^3$	monthly max 1 hr av. $\mu\text{g}/\text{m}^3$	date max 1 hr occurred	monthly max 24hr av. $\mu\text{g}/\text{m}^3$	date max 24 hr average occurred	quarterly average $\mu\text{g}/\text{m}^3$
July 2007 (non FEM)	na	na		na		na
August 2007 (non FEM)	na	na		na		na
September 2007 (non FEM)	na	na		na		na
October 2007 (non FEM)	na	na		na		na
November 2007 (non FEM)	na	na		na		na
December 2007 (FEM)	1.5	19.0		13.0		1.5
January 2008 (FEM)	1.7	19.0	1/31/08	6.5	1/15/08	
February 2008 (FEM)	3.1	34.0	2/24/08	12.6	2/24/08	
March 2008 (FEM)	2.5	17.0	3/17/08	8.5	3/29/08	2.4
April 2008 (FEM)	3.0	21.0	4/15/08	10.3	4/30/08	
May 2008 (FEM)	4.8	44.0	5/18/08	20.5	5/18/08	
June 2008 (FEM)	3.8	21.0	6/16/08	9.5	6/30/08	3.9
Annual	2.9	44.0	5/18/2007	20.5	5/18/2007	thru 6/30

Basin NextGen BAM (PM_{2.5})



Basin NextGen BAM (PM_{2.5})

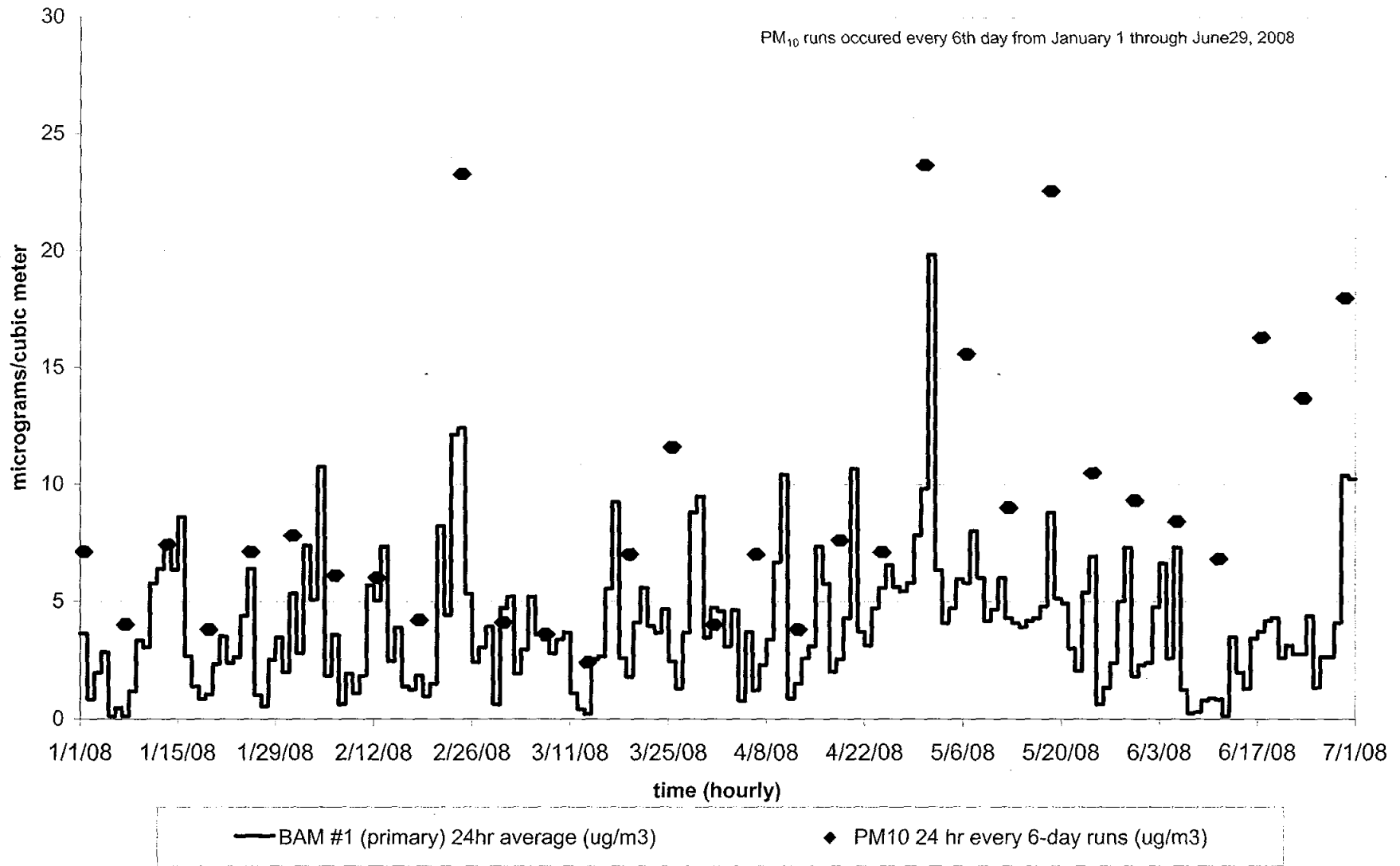


Table 7-13 PM_{2.5} AAQS Analysis

Pollutant	Averaging Period	Predicted Basin Contribution to Maximum Impact	Predicted Off-Site Source Contribution to Maximum Impact	Background Concentration ³	Maximum Total Impact	AAQS	Percent of AAQS
		(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(%)
PM _{2.5}	24-hour ¹	8.38	0.09	18.10	26.57	35	76
	Annual ²	1.26	0.01	8.97	10.24	15	68

¹High-eight-high model-predicted impact.

²High-first-high model-predicted impact.

³3-yr average of the 98th percentile values from 2005-2007 for Aberdeen, SD. The annual average is the highest annual average concentration over the 3-yr period from 2005-2007 for Aberdeen, SD.

Summary of Annual PM_{2.5} Monitoring at Aberdeen, SD

Location 111 2nd Ave SE, Fire Station #1, Aberdeen SD

All air quality data in µg/m³.

Year	No. of Obs	98 th Percentile	Annual Average
2005	122	21.7	8.97
2006	121	18.1	8.18
2007	120	14.7	7.97
Overall		18.2	8.37

BACT Main Boiler Pollution Control Equipment Cost Break Down

	Ammonia FGD & Fertilizer Plant	Fabric Filter	Sorbent Injection	SCR
Capital Cost				
Total cost	\$232,820,000	\$54,880,000	\$3,780,000	\$37,520,000
\$/kW	\$310.43	\$73.17	\$5.04	\$50.03
Operation and Maintenance Cost				
Reagent/Sorbent	\$10,860,000	\$0	\$1,300,000	\$1,120,000
Catalyst or Bags	\$0	\$4,500,000	\$0	\$660,000
Maintenance	\$2,840,000	\$200,000	\$14,000	\$130,000
Fertilizer	-\$15,900,000	\$0	\$0	\$0
Propane	\$220,000	\$0	\$0	\$0
Power	\$6,410,000	\$2,560,000	\$43,000	\$1,710,000
Total O&M	\$4,430,000	\$7,260,000	\$1,357,000	\$3,620,000
Net Present Value & Levelized Cost				
30 Payments (n)				
6.0% Discount Rate (d)				
3.0% Inflation Rate (i)				
Capital NPV	\$232,820,000	\$54,880,000	\$3,780,000	\$37,520,000
O&M NPV ¹	\$87,818,944	\$143,919,985	\$26,900,747	\$71,761,756
Total NPV	\$320,638,944	\$198,799,985	\$30,680,747	\$109,281,756
Levelized Cost ²	\$23,294,070	\$14,442,603	\$2,228,923	\$7,939,201
Average Control Cost³				
Inlet Rate ⁴	1.25	6.5	10	0.15
Units	lbs SO2/Mbtu	lbs Ash/Mbtu	lbs Hg/Tbtu	lbs NOx/Mbtu
Technology Removal	96.0%	99.82%	15.0%	66.7%
Emission Rate ⁴	0.05	0.012	1	0.05
Units	lbs SO2/Mbtu	lbs Ash/Mbtu	lbs Hg/Tbtu	lbs NOx/Mbtu
Removed**	36,792	198,922	92	3,066
Units	tons SO2/yr	tons Ash/yr	lbs Hg/yr	tons NOx/yr
Average Removal Cost	\$634	\$73	\$24,233	\$2,589
Units	/ ton SO2	/ ton Ash	/ lb Hg	/ ton NOx

1 Calculation Methodology: $(1+i)^n \cdot (1-(1+i)^{-n}) / (i-i)$ * first year cost

2 Calculation Methodology: $(d \cdot (1+d)^n) / ((1+d)^n - 1) \cdot NPV$

3 Assumes 100% copacity factor.

4 Mercury removal assumes 0.11 ppmd, 11,000 Btu/lb, 75% removal in the fabric filter w/o ACI (total mercury removal = 90%).

Attachment 4

Emission Calculation from TANKS Program

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	TK01
City:	Selby
State:	South Dakota
Company:	Basin Electric Power Cooperative
Type of Tank:	Vertical Fixed Roof Tank
Description:	Vertical Fixed Roof Tank Fuel Oil Storage Tank

Tank Dimensions

Shell Height (ft):	40.00
Diameter (ft):	50.00
Liquid Height (ft):	34.00
Avg. Liquid Height (ft):	17.00
Volume (gallons):	500,000.00
Turnovers:	2.30
Net Throughput(gal/yr):	1,150,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meteorological Data used in Emissions Calculations: Aberdeen, South Dakota (Avg Atmospheric Pressure = 14.05 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

TK01 - Vertical Fixed Roof Tank
Selby, South Dakota

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Distillate fuel oil no. 2	All	45.17	39.39	50.96	43.45	0.0038	0.0031	0.0047	130.0000			188.00	Option 1: VP40 = .0031 VP50 = .0045

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

TK01 - Vertical Fixed Roof Tank
Selby, South Dakota

Annual Emission Calculations

Standing Losses (lb):	64.2018
Vapor Space Volume (cu ft):	46,183.0482
Vapor Density (lb/cu ft):	0.0001
Vapor Space Expansion Factor:	0.0417
Vented Vapor Saturation Factor:	0.9953
 Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	46,183.0482
Tank Diameter (ft):	50.0000
Vapor Space Outage (ft):	23.5208
Tank Shell Height (ft):	40.0000
Average Liquid Height (ft):	17.0000
Roof Outage (ft):	0.5208
 Roof Outage (Cone Roof)	
Roof Outage (ft):	0.5208
Roof Height (ft):	0.0000
Roof Slope (ft/ft):	0.0625
Shell Radius (ft):	25.0000
 Vapor Density	
Vapor Density (lb/cu ft):	0.0001
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid	
Surface Temperature (psia):	0.0038
Daily Avg. Liquid Surface Temp. (deg. R):	504.8432
Daily Average Ambient Temp. (deg. F):	43.4292
Ideal Gas Constant R	
(psia cu ft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	503.1192
Tank Paint Solar Absorptance (Shell):	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700
Daily Total Solar Insulation	
Factor (Btu/sq ft day):	1,290.2500
 Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0417
Daily Vapor Temperature Range (deg. R):	23.1516
Daily Vapor Pressure Range (psia):	0.0016
Breather Vent Press. Setting Range (psia):	0.0600
Vapor Pressure at Daily Average Liquid	
Surface Temperature (psia):	0.0038
Vapor Pressure at Daily Minimum Liquid	
Surface Temperature (psia):	0.0031
Vapor Pressure at Daily Maximum Liquid	
Surface Temperature (psia):	0.0047
Daily Avg. Liquid Surface Temp. (deg R):	504.8432
Daily Min. Liquid Surface Temp. (deg R):	499.0553
Daily Max. Liquid Surface Temp. (deg R):	510.6311
Daily Ambient Temp. Range (deg. R):	23.6250
 Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9953
Vapor Pressure at Daily Average Liquid:	
Surface Temperature (psia):	0.0038

Vapor Space Outage (ft):	23.5208
Working Losses (lb):	13.6125
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0038
Annual Net Throughput (gal/yr.):	1,150,000.0000
Annual Turnovers:	2.3000
Turnover Factor:	1.0000
Maximum Liquid Volume (gal):	500,000.0000
Maximum Liquid Height (ft):	34.0000
Tank Diameter (ft):	50.0000
Working Loss Product Factor:	1.0000
Total Losses (lb):	77.8143

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

TK01 - Vertical Fixed Roof Tank
Selby, South Dakota

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	13.61	64.20	77.81

Table 4-3 Summary of Technically Feasible NO_x Control Technologies

Control Technology	Emission Limit (lb/MMBtu)
SCR	Selected as BACT
SNCR	(0.10) - 30-day
LNB Alone	25-30% (0.25-0.40)
OFA Alone	25-30% (0.25-0.40)
Gas Reburn Alone	25-60% (est 0.25-0.30 lb/MMBtu)

Table 4-6 Summary of Technically Feasible SO₂ Control Technologies

Control Technology	SO ₂ Emission Limit (lb/MMBtu)
Wet FGD	Selected as BACT
Advanced Dry Scrubber	94% (0.07)
Dry FGD (LSD)	94% (0.07)
HLI	0% Removal
Coal Cleaning	10-50% from coal. However, such controls will result in no emission reduction because review is already based on limited sulfur content in the fuel.

Summary of Technically Feasible PM, PM₁₀ and PM_{2.5} Control Technologies

Control Technology	PM Emission Limit (lb/MMBtu)
FF Baghouse	Selected as BACT
ESP	>99.9% (0.012)

Summary of Technically Feasible H₂SO₄ Mist Control Technologies

Control Technology	PM Emission Limit (lb/MMBtu)
FF and Wet FGD	Selected as BACT
Dry FGD	N/A
Wet ESP	N/A
Reactant/Sorbent Injection	>90% (0.005)

Summary of Technically Feasible Fluorides Control Technologies

Control Technology	PM Emission Limit (lb/MMBtu)
FGD Technologies	Selected as BACT
PM Control	Selected as BACT
Sorbent Injection	0%

POINT AND NON-POINT SOURCE EMISSION POINTS

Tables already included for each of these sections. No further tables of emission rates needed.

EMERGENCY GENERATOR

Summary of Technically Feasible NOx Control Technologies for Emergency Generator

Control Technology	Emission Reduction (%)
SCR	90%
Ignition Timing Retard	20-30%
Lean Burn Combustion	6-10%

Summary of Technically Feasible PM Control Technologies for Emergency Generator

Control Technology	Emission Reduction (%)
PCV	90%
Low-Sulfur Fuels	Selected as BACT
Good Combustion Practices	Selected as BACT

EMERGENCY DIESEL FIRE PUMP

Summary of Technically Feasible NOx Control Technologies for Emergency Fire Pump

Control Technology	Emission Reduction (%)
SCR	90%
Ignition Timing Retard	20-30%
Lean Burn Combustion	6-10%

Summary of Technically Feasible PM Control Technologies for Emergency Fire Pump

Control Technology	Emission Reduction (%)
PCV	90%
Low-Sulfur Fuels	Baseline
Good Combustion Practices	Baseline

Auxiliary Boiler

NOx Table already included (Table 4-35). No other tables necessary as all are not feasible.

Fertilizer Rotary Drum Dryer Burner

No tables necessary as all controls are not technically feasible.